

Type 2 Diabetes, Falls, and Disabling Hip Fracture Risk and Outcomes Social Determinants: A Complex Web of Many Possibly Modifiable Poorly Addressed Remedial Factors?

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ABSTRACT

Type 2 diabetes, a predominantly adult form of this widespread commonly chronically progressive disabling health condition, is one that appears increasingly present among many older adults, who are also at high risk for falls and osteoporotic as well as non-osteoporotic fractures, such as that at the hip joint that is especially devastating. This brief summarizes some possible pertinent findings regarding a possible role for social factors, such as externally derived environmental attributes in this regard, including the role of socioeconomic inequities. We conclude that in addition to possible resource deprivation, an associated increasingly sedentary oriented lifestyle, disparate or suboptimal health access, fast food advertising and availability among other factors warrant attention and hold promise for possibly reducing type 2 diabetes risk and severity, as well as subsequent costly falls and hip fracture risks. Public health messaging and opportunities to counter the sedentary, passive lifestyles of many, plus more efforts to reduce food marketing messages and sugary drinks to youth and adults should prove helpful in multiple tangible respects.

Keywords: Aging, Falls; Hip Fractures; Prevention; Social Determinants, Type 2 Diabetes

Background

It is well established that pre diabetes and the onset of its variant termed type 2 diabetes/mellitus if not intervened upon and averted in a timely precisely targeted manner will yield and impose multiple disabling functional impacts on an older adult that are relatively impervious to sublimation, arrest, mitigation, or reversal, especially in societies that follow Western lifestyles. This situation remains problematic because the presence of one or more of the many adverse type 2 diabetes ramifications remains a well-established prominent cause of premature and excessive morbidity, as well as possible premature mortality among a sizeable percentage of the aging population [1,2] in its own right in an era where adults are living longer, but where life quality and independence greatly sought and highly prized but may be duly jeopardized as well costly. This may be because the condition commonly affects multiple organs and body systems, and may do so more profoundly at the higher ages, as opposed to type 1 genetic or autoimmune diabetes that may be longstanding and less impacted by the added disadvantage of age, and possible overall aging declines in multiple body systems, but may not

exclude lifestyle factors and exposures or lack of exposure to safe health practices that go beyond the individual.

In addition to adversely impacting the overall wellbeing of an older adult, the costs and associated debility in the face of the disease may be heightened by its impact on falls risk and bone fractures often unanticipated by the older adult as well as the provider in our view. Its specific impact on hip fracture risk and severity, and the subsequent possible adverse influence of a hip fracture injury on diabetes status alone and one that surely represents an unwanted costly public health burden requires urgent timely primary as well as secondary preventive efforts in its own right in our estimation as outlined by many [3-8]. Unraveling the web of causation here is not simplistic however, and demands an analysis and clear understanding of the diverse possible predisposing, reinforcing, and enabling factors that mediate or moderate type 2 diabetes as well as its correlated falls and other hip fracture determinants [8].

This brief summarizes what has emerged in this regard as far as the topic of type 2 diabetes and its hip fracture impacts and whether there are possible preventive upstream pathways that can alleviate any magnified cause for concern in the case of

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the older type 2 diabetic who may already be subject to multi-morbidity. For example, as far as being susceptible to muscle and bone mass losses in the face of poor glycemic control engendered by an excess sugary food intake, a lack of safe walking spaces, food ‘deserts’, and pollution impacts, among others. Based on the most recent data in the literature, here we specifically strove to examine hip fractures and their relationship to type 2 diabetes from an extrinsic, rather than an intrinsic lens where self-efficacy, health beliefs, health practices, and self-care behaviors dominate [8]. In particular, we try to articulate why the condition is a serious one, why social factors are of potential import, who is duly or potentially affected, what are some reasons for their persistence, and what are prevention strategies that can potentially offset the generally increasing hip fracture prevalence and severity among the older adult type 2 diabetes population whether they are frail or obese as outlined over time [9-12].

This effort was undertaken given the immense numbers of older adults desiring to live ‘in place’, but who may fail to do so if impacted uncontrollably by type 2 diabetes and a high recurrent falls rate and fracture potential. We specifically sought to examine if more attention is needed here as far as averting the potentially modifiable causes of adult-onset type 2 diabetes and its perpetuation and that arise largely from extrinsic factors, rather than glycemic control issues alone. Given the rise of the disease in previously healthy young adults [6] we hypothesized that older adults with type 2 diabetes who remain at a higher risk for falls including non-injurious skeletal falls and concerns therefore, and that may continue to incur hip fractures at a rate greater than that of those who remain disease free, especially if insulin dependent, or presenting with a reduced bone mineral density at time of injury or persistent movement fears [10,11]. Moreover, with few signs that type 2 diabetes correlates are being addressed in primary care to any degree, we anticipated researchers would continue to observe cases with type 2 diabetes to exhibit poorer health outcomes even in the face of advanced hip fracture repair surgical solutions, especially when differentiated by physical fitness measures and attributes, and possibly reflecting the rise of sedentary lifestyles and behaviors as major type 2 diabetes and chronic disease determinants. Moreover, this adverse series of events would persist as of 2026 despite a well-articulated prior need for more vigilance against this debilitating health condition that was raised previously by us and many others [11-14] and has pointed to an obvious role for non-medical insights and action plans in the diabetes type 2 prevention and intervention realm that continues to be overwhelmed and largely overshadowed by medically-oriented uni-dimensional interventions, rather than not.

Indeed, in this regard, hip fractures, an important costly health concern in aging populations, and one that commonly leads to disabling hip osteoarthritis, functional disability, and/or premature death can be induced in the presence of chronic type 2 diabetes. In our view therefore, at least some hip fractures and their consequences may not be inevitable among aging adults but can be mitigated or arrested by addressing some probable environmental and social underlying determinants of these conditions rather than individual factors such as biology, knowledge, and personal factors. These include but are not limited to the influence of the factors listed below on health behaviors in the face of a lack of:

- Affordable foods.
- Accessible foods supply/rise of food ‘deserts’
- Food policies/lack thereof.
- Community structure/eg., may not foster walking.
- Schools defer health and physical education-in favor of 3 R’s
- Family practices-may prefer fast foods.
- Social media messages-may encourage high fat content food/energy drink purchases.
- Social network influences-probably underestimated among youth.

Drawn from pertinent literature sources published in the peer reviewed English language largely between January 1 2020 and September 1 2026 concerning hip fractures, type 2 diabetes associations and what appears to influence these linkages other than biology alone the specific questions of current interest addressed herein were:

1. Is there a consistent relationship between the presence of type 2 diabetes and the risk of encountering or adopting unhealthy social trends or environmental obstacles to health that are pervasive?
2. Can more effective social policies designed to address adverse social situations that appear to influence diet and exercise behaviors that impact type 2 diabetes risk, including more support for physical activity and control of social media screen content impact this risk, and thereby at least some later life falls and injurious hip fractures?
3. What are some other uncharted external community-based options that could be harnessed in this respect?

We have not focused here on the many other potentially remediable underpinnings of type 2 diabetes or hip fracture incidence, such as the presence of lifelong excess body weight and muscle fat infiltration, but assumed the diabetic condition manifests in part, due to early or persistent socially influenced and adopted behavioral factors rather than genetics or age, such as limited access to sound health and eating practices and messages, nutritious foods, and bouts of regular physical activity participation.

Methodological Procedures

To explore our premises, we sought an array of peer reviewed data sources that might provide topical information and interrelated ideas on type 2 diabetes origins, the link between type 2 diabetes and later life hip fractures, the possible implications of this information when viewed through a sociological lens. Data sources published in the English language and covering the emergence of this topic from its early as well as current 2026 postings, and available at PubMed, Academic Search Complete, Google Scholar, PubMed Central, and Science Direct when applying the key words Epidemiology. Hip Fractures, Social Determinants of Health, Type 2 Diabetes [Mellitus], Type 2 Diabetes, as applied to older adults [> 65 years]. Due to the diversity of the literature and its lack of focus with the exception of anti-diabetic or bone building pharmacologic strategies, a meta-analysis of one or more preventive efforts to obviate type 2 diabetes in its own right or as a falls correlate that commonly predates hip fracture incidents was not possible. Rather, a narrative overview of the data as derived from clinical studies, and systematic reviews as to the causes, consequences, and possible control of the hip fracture risk in type

2 diabetics was conducted. We chose to focus on type 2 diabetes as many of its underpinnings appear preventable, rather than not, such as inactivity and its association with age related falls and fractures as well as type 2 diabetes bone attrition severity. Data on fractures in general were excluded, as were hip fracture surgical studies and all types of hip fracture were surveyed collectively. The focus was on social determinants rather than personal determinants of type 2 diabetes and how remedial action here could possibly obviate falls and fracture risks in later life. The term type 2 diabetes was used rather than type 2 diabetes mellitus, and which are analogous. The data were supplemented by the author's research base detailing the disability risk associated with factors beyond the control of the individual. All articles that dealt with these key issues were eligible for review, and relevant data were itemized and analyzed qualitatively for any trends. Hip fractures were not classified according to their major sub-groupings, but treated as a composite entity, as were gender and age range dimensions, and their possible underlying modifiable falls and fracture risk links, such as declines in muscle and bone mass as well as food access and health promotion opportunities. We applied the term physical activity to denote any bodily movement caused by muscular contractions that culminates in the expenditure of energy.

The discourse is however, specifically limited to understanding the possible interaction of these linkages among community dwelling older adults rather than young adults or those in nursing homes or the hospital setting post hip fracture surgery.

Premise

Sedentary behaviours and their impact on physical fitness likely foster a high risk of incurring a diabetes type 2 conditions in an adult, and later on, a strong link to episodic falls and bone injuries that often impact the hip with dire consequences. Similarly, poor health services access, food 'deserts and lack of healthy affordable foods, insurance coverage issues, a lack of school based physical education, health and nutrition learning, and widespread sugary drink and high fat food offerings may incrementally jeopardized both weight as well as the overall health status of many youths and adults inadvertently.

In particular, this report rests on the idea that there are possible opportunities for heightened preventive actions against type 2 diabetes and by analogy, late life hip fracture risk and the writer assumes the causes and consequences of type 2 diabetes are more readily explained by adopting a socio ecological discovery framework rather than an individual level deterministic perspective alone.

Key Findings

Type 2 Diabetes

Type 2 diabetes, a growing diabetes sub-grouping and one believed to be non-insulin dependent, is a pervasive chronic progressively destructive metabolic health condition affecting the ability of the individual to utilize glucose effectively and that has multiple dire health ramifications. A health condition constituting a burgeoning problem among the older adult population, it is one often increasingly traceable to behaviors adopted inadvertently or not readily pursued in early adulthood, rather than genetics, or age, such as the magnitude of physical activity participation.

Although this finding alone seems to offer a ready-made preventive strategy, as indicated by 59867 related citations on this topic alone since 1972, as posted on **PUBMED** as of September 4, 2026, type 2 diabetes remains a potentially potent functional disabler of many older adults no matter where they reside, and remains a condition where the inability to moderate glucose levels is a strong bone health determinant and one possible exacerbated by low levels of physical activity participation, poor nutrition, and the perpetually high rates of screen time usage among youth and adults [7,12-14]. Even when attempted, possibly in isolation, a systematic review revealed the majority of participants who set out to improve their participation, failed to achieve their goals at each timepoint to the extent of 57.9% up to 77.0%), and that rates of achievement declined over time, especially where there was a top-down approach [19].

This possible overall scenario while potentially differing across diverse regions and geographic locations [15] is one that clearly persists in the face of increasing numbers of youth and adults who are exposed to or appear increasingly predisposed to inactive lifestyles and high childhood obesity rates in the midst of pervasive technology usage and even passive modes of therapeutic application, plus online learning in schools as well as therapies, cheap transportation, and automated food delivery factors despite volumes of research and strong indications of a role for fostering sound nutrition and physical activity participation across the lifespan as well as in the case of diabetes type 2, falls and fracture prone older adults [9-14]. Yet it seems, when viewed in isolation, type 2 diabetes remains seemingly impervious to mitigation, reversal or prevention, even though calls have been made to go beyond pharmacologic treatment methods, wherein a focus that can be extended towards addressing the social/epigenetic, social adversity, food security, food messaging, obesogenic influences, and delivery systems, as related to the more well-articulated behavioral determinants and pathways may help to prevent the development and perpetuation of at least some type 2 diabetes cases and its enormous personal and public health costs and possible under recognized manifestations of musculoskeletal pain [2, 15-23].

Hip Fractures

For more than 50 years, ample research has shown hip fractures that commonly involve damage to one of three predominant local bone sites of the proximal thigh bone, tend to occur largely in older adult populations, where they may yet lead to premature death, high rates of morbidity, independence losses, or reductions in life quality, especially in the presence of co-existing health conditions. In recent years, hip fractures have not only been identified as one of the most serious health care problems facing health policy makers and public health care organizations, but this form of unintentional injury remains highly problematic despite being the target of a voluminous amount of research that has extended for many years alongside multiple public health endeavors and others to reduce their occurrence and/or severity. Yet, with the exception of a few global regions where bone building treatments have been employed, the lifetime risk of incurring a hip fracture has not decreased sufficiently over the last few decades and high numbers of incident cases continue to prevail. This is despite a large body of knowledge that included more than 440 citations in PUBMED since 1994 and a variety of contemporary preventive and refined surgical approaches plus

clear indications that those worse off, are older adults in poor health.

Type 2 Diabetes and Its Multiple Adverse Impacts

In many respects, especially given its disabling impact on the sufferer incurred directly by a deficit in glucose control, the aging type 2 diabetes adult may predictably experience serious progressive falls events, nerve damage and pain, blood vessel, and organ related damage [16]. Moreover, they may incur eye, kidneys, heart and vascular system damage that may well converge additively and progressively to negatively influence mobility, bone attrition, social interactions, and the risk of an injurious fall on the hip, and its dire consequences [24-29].

As well as impacting the ability of the affected older adult to function painlessly, safely and independently, and to carry out glucose control self-care strategies, alone or combined with a fracture injury, those with unrelenting type 2 diabetes may suffer multiple adverse cognitive alterations that are often injurious in their own right, such as depression and social fragility [24]. A disease often linked to an exaggerated degree of physical frailty, and recurrent falls mediated injuries, subjects may develop bone fragility and structural abnormalities, neuropathic pain, feelings of anxiety and distress, as well as fears of falling plus an environment and medical system that largely engenders or refrains from discouraging sedentary behaviors, for example offering on line diabetes education rather than active attendance at community-oriented events [29-36].

Additionally, social determinants of diabetes may go unacknowledged or unchecked, as may the presence of obesity often thought to be a bone protector, thus not considered a fracture risk factor. However, this belief may be falsely reassuring because type 2 diabetes can readily induce unwanted osteoporotic bone attrition or structural features that succumb readily to mechanical impacts regardless of body weight. In addition, although type 2 diabetes predictably proves to be a highly pertinent disabling determinant of poor health outcomes in general, as well as injurious falls, most treatment protocols continue to focus on the pharmacological forms of reducing excess glucose and bone loss, rather than on other modalities such as exercise or access to this that may combat its progression and spread.

Due possibly to erroneous beliefs of the idea type 2 diabetes is not one amenable to prevention, the motivation to examine and act on factors other than passive drug interventions has not been widely forthcoming and therefore remains an untested idea. The fact is, even if only a small number of type 2 diabetes cases do incur a hip fracture, the costs here of a single injury is hard to calculate over a lifetime, especially in an era of increasing longevity. A single hip fracture may induce premature mortality at rates unchanged over literally decades or a life of possible declining function at rates that remain greater than those of disease-free adults. They may also fall more readily [16-18].

Additional research reveals that older people with type 2 diabetes especially those with measureable muscle strength declines, postural dyscontrol, and functional impairments are likely to have up to a 2.5 fold increased risk of incurring a) a future injury, b) having a higher fracture, impaired mobility and

health-related functional risk [20-22], c) ensuing bone related changes, such as accelerated bone mass losses or actual bone mineral density increases, and d) muscle mass declines [22-25].

This may partly reflect the broader role of physical activity history, often pursued less frequently in Western society even though ample data show physical inactivity, or too little physical activity is a leading risk factor for chronic diseases, such as type 2 diabetes [54].

On the other hand, both adults and children who regularly participate in physical activity and sound nutrition practices that appear to work synergistically through the same metabolic pathways can potentially:

- Reduce their risk of developing unwanted body weight and body fat deposit excesses plus the onset and perpetuation of insulin resistance, high blood pressure, heart attacks, stroke, depression, anxiety, and the risk of falls and fracturing a hip.
- Improve their bone, muscle, and joint health, as well as the ability to function physically, socially, and cognitively.
- Increase their energy supply, and reduce fatigue.
- Increase their chances of living a longer high-quality life.
- Lower health care costs/numbers of doctor visits.
- Promote sleep quality, as well as mobility.
- Promote self-esteem, stress control, body image, and general confidence.
- Improve self-discipline, and socialization opportunities.
- Reduce the need for toxic or risky medications [51,54].

The lifelong pursuit of a physically active lifestyle coupled with high value nutrients also appears to help aging adults to optimize their bone health, joint flexibility, muscle strength, muscle mass, gait, and balance and thereby to possibly mitigate the potential risk for recurrent falls and fractures and a life of low quality and suffering, especially among those with sarcopenia [age related muscle mass losses] that can affect physical as well as cognitive functioning. Similarly, subjects who weight-bear regularly may be less likely to sustain a hip fracture than those who do not [38-42].

In addition, when low physical activity participation is coupled with a vitamin D deficiency, this significantly increases both the risk of incurring a fall induced hip fracture, as well as poor bone and muscle health, painful diabetic neuropathy, and a high chance of premature mortality [9]. This may stem inadvertently not only from multiple societal factors but from a parallel lack of vitamin D containing foods, as well as limited outdoor exposure to sunlight linked to possible severe fast twitch muscle fiber atrophy, a neuromuscular change that may weaken bone protection, as well as fostering insulin resistance [42-45].

On the other hand, the importance of recognizing activity barriers due the built environment, unsafe walking areas, enforced work-based screen time, inadequate nutrition, and air pollution, the chances of being a physically fit adult across the lifespan may be jeopardized significantly. Moreover, a lack of sufficient physical activity opportunities may hasten an aging decline in bone and muscle strength and thus the force required to fracture a bone especially if bone composition is additionally compromised by the presence of type 2 diabetes and related glucose control medications and sensory deficits.

Added to this cycle of envisioned adverse events, is a probable type 2 diabetes decline in muscle force generating ability, balance control, gait speed, vision acuity, and possible worsening diabetic signs that raise the risk for falling and sustaining a hip fracture regardless of body mass index and especially in the face of tight glycemic control [15,19,21]. Outcomes after a hip fracture in the face of all its possible cumulative health burden [16-30] and possible secondary lethal hip fractures risk [31] in those with a history of hypoglycemia or neuropathy [32] may also be traceable to remediable factors such as poor muscle strength [33,34], bone mass losses [8] and possible micro vascular neuropathic complications of intrinsic as well as extrinsic origin [35-37].

In Short, It Appears:

A host of extrinsic mediators such as a lack of lifelong physical activity opportunities alongside poor nutrient access is not only an immense global, as well as nationwide public health problem in its own right, but a risk factor for several potentially preventable adult-onset diseases such as type 2 diabetes [46] where reportedly, 27.5% of adults aged ≥ 50 years may fail to exercise regularly [46, 47]. This is contrary to what the data have and are showing, namely:

- Physical activity participation, whether structured or unstructured, may foster more optimal health for all regardless of age, as may the adoption of low caloric based diets if accessible and supported by policy makers, economists, families, communities and health providers as well as the individual.

In particular, more unified and dedicated long term investments to encourage improved physical fitness and optimal nutrition opportunities for all across the lifespan especially where outdoor activities may be unsafe, and food costs excessive are strongly advocated [54]. The costs of this investment, while not marginal, are indeed likely to outweigh the costs of failing to do this across the population, thus severely impairing longevity in some cases, and life quality and the ability to function physically and socially in not other especially if injurious falls become recurrent and impact bone. By contrast, older adults with an established type 2 diabetes diagnosis who undertake physical activity and can actively choose to avoid or resist the 'perceived benefits' of high glycemic or high fat containing 'comfort' foods or are not well instructed or provided with resources in this regard are likely to be worse off at all stages of the disease than not. As well, their rates and extent of recovery if they do fracture a hip are likely to be suboptimal [6] if they have not been and are still not strongly encouraged to overcome any sedentary or poor health practices, but to rely solely on glucose monitoring [48] and surgical expertise. They may also have to be housed in hospital for longer periods than desired, and experience lengthier surgeries than those with no health condition, as well incur future complications requiring hospitalization and the use of opioids if they are insulin users [49-51].

Those who are physically inactive, with poor access to care either retrospectively or in the future, as well as those who lack funds to supplement their care, may also continue to exhibit deficient bone quality profiles and/or subnormal body weights and an adverse changing ratio of muscle mass to visceral fat and thereby poor and declining muscle contractile functions [42,52].

They may also be at an especially high risk for developing painful diabetic foot ulcers as a result of diabetic neuropathy that reduces the motivation to weight bear [45, 53-55], while those who fall due to this and associated poor dynamic balance control may be at further risk due to an increased fear of falling, plus a further reactive decline in the ability to enact rapid favorable reflexive shock absorbing neural responses on demand that may enhance a cycle of recurrent falls and sedentary practices and movement avoidance [14,56,57].

Among the many debilitating diabetes linked impacts that may greatly degrade day to day wellbeing and induce a substantially higher risk of sustaining a diabetic-linked hip fracture than not [39-42] their demise may well be traced to or impacted to some degree by intersecting sociological factors such as food access and quality issues that engender a state of:

- i. Poor walking endurance, and increases in gait unsteadiness [58]
- ii. Muscle density declines [59]
- iii. Subnormal muscle fat ratios [43,52]
- iv. Physical performance deficits [9]
- v. Possible sleep challenges and poor glucose control [58]
- vi. Vitamin D exposure deficits [33,34]

To the contrary, this group may yet be able to substantively mitigate a proportion of their type 2 diabetes manifestations and ongoing risk of a recurrent falls, secondary hip fracture, a fracture at a another site [61], and a possibly declining cognitive health status [48] by assuming efforts of providers to foster their willingness to be more active and to counter any undesirable eating dietary practices as well as helping them acquire the resource support needed to do this.

Indeed, in our estimation, prevention efforts applied in isolation and regardless of resource and accessibility issues may only serve to reinforce the chances of achieving an adverse costly and burdensome health outcome in multiple respects.

Discussion

As outlined above, type 2 diabetes, a chronic health condition, and one increasing rapidly among the older populations who are also at high risk for falls and hip fractures remains a major health concern and one where vulnerable older adult may not be receiving optimal protective care or are encountering a worsening of their situation even if they were previously healthy. This is difficult to fully comprehend given at least 80 years of related study, but one that has yielded little in the way of advancing outcome expectations or improvements, despite a plethora of documented or envisioned possible preventive options to offset their combined dire public health and personal implications. Because these intertwined problems seem pervasive, modifying their determinants sooner rather than later appears crucial.

Indeed, we anticipate that improvements in this realm of any degree will have immense current as well as future public health ramifications and may help to diminish untold human costs while reducing this projected dual health burden. We elected to examine the link between the onset of type 2 diabetes and that of incurring a fall and subsequent fracture from a sociological vantage point, rather than explanations based on age or gender alone. The aim was to determine the degree to which any

additionally enumerated deterministic factors are likely to be strongly preventable, remediable, or reversible targets in respect to the onset and perpetuation of adult type 2 diabetes.

From our very extensive search we affirm that what emerges here, which is basically an unchanging landscape, is indeed one where despite an urgent need to reduce the older adult's falls risk and a related immense hip fracture burden and a great deal of suffering engendered in these realms by type 2 diabetes reactions and interactions, very few non-medical carefully targeted preventive efforts here have been forthcoming. That is, while multiple data sources point to there being an overall minimal reduction in hip fracture occurrences and severity over time, and especially premature mortality rates, their related adverse outcomes in the presence of type 2 diabetes remain [11,15,59-65].

However, mounting evidence of a cross-cutting need for muscle and bone optimization, a parallel role for life-long physical activity participation and sound nutrition practices across the lifespan does currently prevail and when enacted may help to markedly curtail the need for costly glycemic control medications and others that themselves are not risk free.

Proposed Countermeasures

Possible countermeasures to offset these aforementioned unwanted apparent interlocking health events, include efforts by policy makers, town planners, and others to encourage physically active lifestyles, alongside food marketing monitoring, and access, plus environmental health and safety issues.

In particular, opportunities for varied low or no cost enjoyable weight bearing albeit moderate impact activities, balance training and possible exposure to vitamin D at its source appear of high potential value whether the bones are already brittle or not [50,67].

Linked to diabetes education, falls/injury prevention courses and widespread supportive social marketing messaging interventions that encourage safe physical activity for all and discourage

inactivity are also indicated. Countering exposure to negative media messages and those that encourage passivity and false beliefs are especially desirable in the face of policies that may not be protective or implemented with fidelity or for protracted periods, and that may yet engender degrading physical or disease associated social and cognitive declines inadvertently [64, 68-70]. Having well trained school health personnel and administrators, and investing in safe schools and communities, high calibre school lunch programs that extend into the vacation period, as well as informed health providers and community health workers also appear to offer a heightened chance for many to counter the onset of debilitating type 2 diabetes, plus its burdensome disabling consequences, and where sarcopenic obesity, a high ranking diabetes determinant raises the risk for one or more hip fractures [71] that can be traced to modifiable factors such as social disadvantage.

In addition, health affirming classrooms, and worksite strategies, making healthy foods available, and rewarding efforts to improve the patient's health may incentivize young and older adults as well as providers to overcome a sole reliance on various pharmacologic intervention options applied as secondary or tertiary strategies [69,72]. Moreover, overweight individuals who would be expected to have a relatively higher proportion of body fat than average may benefit specifically from targeted long-term counseling.

Opportunities to be more active, such as the organization of dance clubs, sports clubs, or community gardening, is also expected to be as advantageous or more advantageous than medication alone.

In sum, policy makers, clinicians, and researchers who are willing to consider reframing type 2 diabetes origins to embrace its likely ecological correlates and apply efforts to counter their potential collective influences may not only find they can obviate the onset of some type 2 diabetes manifestations, but related falls and injuries as conceptualized in Figure 1.

POSSIBLE DETERMINISTIC ATTRIBUTE	+	HYPOTHESIZED EXPLANATIONS
Access to high quality health care		disparities in eligibility/services [31, 32]
Cardiovascular diseases		lack health diet sources, exercise opportunities
Bone fragility/frailty [67]		no time/resources to exercise/prepare calcium-based foods
Childhood obesity		lack of school based physical activity, fast foods, energy drinks
Depression [64]		limited focus/societal bias/stigma/negative media/medical messages
Dizziness		drugs, air pollution, exposure to microplastics [79]
Emotional distress/binge eating		food insecurity, racial profiling/discrimination
Falls		unsafe environments
Falls fears		not examined or treated
High fat diets		socioeconomic/food dessert/health illiteracy factors [30]
Mental health declines		health disparities/structural factors
Muscle weakness/atrophy/sarcopenia		no formal or informal activity opportunity/ethos
Musculoskeletal/neuropathic pain [45]		often ignored/treated by damaging opioids
Polypharmacology		commonly recommended/often unchecked
Shift work and meal timing/content		socioeconomic reasons/profit/savings mediating options [87]
Sleep deprivation/low quality		excessively noisy, hot/cold polluted unsafe environments/lighting [81]
<u>SEDENTARITY</u>		inactive lifestyles are the norm [14, 57, 64, 69, 71, 73]*

Figure 1: Selected factors potentially exacerbating type 2 diabetes onset and thereby falls and hip fracture risk in elders and the possible hypothetical influence of social factors.

*Exemplified by a 2016 study among U.S. adults 50 years old and older.

- 28% were deemed physically inactive.
- Inactivity was 30% higher among those with a chronic disease [47].

Indeed, even if negative studies that do not align with the above ideas are not apparent in the published literature, it appears a role for diverse extrinsic factors in fostering type 2 diabetes risk and by analogy a high falls risk cannot be ignored. This overriding idea that extends to factors beyond an individual's control such as the possible impacts of micro-plastic exposures, air pollution, urbanization, media messaging, the digital divide and fast-food presence on diabetic risk is increasingly obvious to a careful researcher [75, 77-79]. In particular, it must be contended that some aspects of physical activity encouragement and opportunity as well as social norms could greatly determine the magnitude of any type 2 diabetes and hip fracture risk, regardless of age and genetics. Moreover, although personal choices may play a role as well, these may depend on knowledge and resources beyond the scope of the individual to mobilize independently.

Moreover, youth exposed to messages that espouse possible health impairing societal values such as 'climbing the social or wealth ladder' as a life goal or doing well in school rather than in sports may obviate this normative crucial health determinant of play as may health access inequalities, shift work, limited sunlight exposure, unsafe neighborhoods, food deserts, and socioeconomic deprivation [96]. At the same time, even if a case exists for advancing a favorable activity based protective role with regard to hip fractures as well as type 2 diabetes mitigation, the increasing screen time investments made by youth and adults, as well as possible external factors that reduce sleep health [58,80,81], may not only preclude day to day physical activity adoption as the norm, but the energy to do this in the context of non-physiological ambient lighting and noise as well as environmental safety issues that remain relatively unexplored or unaddressed [82] despite their implications for encouraging the lifelong adoption of possible damaging sedentary behaviors [72,73].

Since behaviors adopted in youth are likely hard to modify or eliminate in the adult state, the need to address more health affirming policies and well-designed preventive medicine approaches for all across the lifespan may provide for a preferred future for many especially the high risk socially disadvantaged individual [31]. Encouraging pride in the ability to maintain one's own wellbeing, and fostering environmental health and safety, plus work site practices, as well as offering free gym memberships, and food access may prove highly beneficial as well. Fostering health literacy of community members young and old, as well as policy makers may lessen reliance on a strong drug based set of solutions that has not yielded outcomes commensurate with expectations and costs, but has reinforced sedentary practices, and possible exposures to the diabetes related disadvantages of excess unnatural and artificial nocturnal illumination and late night work activities [82-87], especially among the highest risk groups who are those already socially disadvantaged [31]. Efforts to reduce sitting or screen time in work sites and broad based anti-poverty efforts may be helpful as well [96].

In particular, helping vulnerable youth and older adults to grasp the idea that a physically fit well-nourished state is one less likely to incur or induce type 2 diabetes linked falls and fractures, while averting possible sarcopenic muscle mass declines, sensory impairments, feelings of dizziness, poor balance, and bone mineral density losses may prove beneficial [70] if attention to counteracting the many adverse socially constructed and/or embedded and situated determinants of health are not overlooked [85], and where economic security determinants are treated accordingly among those diagnosed with pre and actually conformed type 2 diabetes diagnoses [86, 88-92]. Bridging the divide as far as digital literacy is concerned is another realm of increasing opportunity to enhance diabetes care for all and allied options for reducing older adult falls and fracture risks [74, 93-95].

Overview and Key Conclusions

Despite the limitations of this report, we feel confident in concluding:

- a) Aging adults with type 2 diabetes may be at high risk for a single or secondary hip fracture especially if they fall and although not well recognized this may be caused in part by one or more modifiable socioeconomic factors.
- b) A better understanding of type 2 diabetes antecedents rather than the risk of failing to do this may save lives as well as enormous health costs and suffering.
- c) The parameters that may play the largest role in this regard are inactivity and sedentary behaviors plus food access and offerings.
- d) Empowering all citizens, including youth to engage in lifelong daily or regular physical exercise, to restrict caloric intake, and to spend less time in passive pursuits, appears essential in efforts to prevent or avert a life of immense late life suffering [73-76] whether obese or not or diabetic or not, but cannot be done readily in isolation.
- e) Those type 2 diabetes cases found to suffer with high bouts of neuropathic pain or vascular impairments, poor balance and gait, muscle and bone mass losses, and/or heightened feelings of stress and anxiety and persistent hypo or hyperglycemia warrant special attention for some time to come especially if inactivity is largely intractable and policies restrict health support and counseling and access [75,76], and exposure to discordant dietary messages, prevail unabated [96].
- f) The adoption of excess sedentary behaviors and high fat sugar-based diets may be inadvertently reinforced and enabled, and espoused, rather than not, in the absence of diet counseling efforts, community support, and fragmented health messages that summate in complex ways to induce great future suffering for many [91,96].
- g) Long term, insightful, personalized, modest low impact non-fatiguing intrinsically valued activity-oriented approaches and food intake plans that are health promoting, appear increasingly indicated and should be supported by 'health in all' policies and encouraged by all medical providers, families, communities, health services personnel and sites, schools, religious gathering venues, social oriented clubs, and workplaces.
- h) Further research to evaluate if addressing ecological factors via targeted interventions can prove helpful for impacting high-risk populations favorably [83,84], as well as the public

health burden directly or indirectly by yielding promising supportive impacts on the factors outlined below:

- o Weight/blood glucose status.
- o Cardiovascular health.
- o Possible primary and secondary fractures/overall falls risks.
- o More favorable bone, muscle mass, strength/endurance status.
- o Better mental health, stress control, physical/cognitive functioning.
- o Longevity/life quality

In the interim, we assert, harmful behaviors that emanate and are likely reinforced by multiple socially determined factors, rather than individual intent and efficacy, currently place the majority of the aging population at risk for a life of suffering in multiple and unrestrained ways that are hard to reverse if not addressed, counteracted or recognized early on and thereafter continuously as indicated. Moreover, we support increasing calls that stress a need for advancing a wider conceptual lens through which to examine the sources of type 2 diabetes.

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